National Aeronautics and
Space Administration
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UCA

Reply to Attn of: 442

AUG 0 2 2000

TO: 214.1/Contracting Officer/Ms. L. Aldridge

FROM: [redacted]/Power System Engineer RJ Broderick 8-2-00

SUBJECT: Technical Evaluation, [redacted] Proposal [redacted], NiH_2 Battery Module Procurement Change

REF: Contract NAS5-[redacted], Part C, Modification Number [redacted], dtd. 5/9/00

Abstract

This is a technical evaluation of the [redacted] Proposal, [redacted], for the procurement of flight batteries for Servicing Mission 4 (SM4), currently scheduled for November 2003. I will refer to [redacted] as [redacted] throughout this evaluation. This proposal is in response to Contract Modification Number [redacted] to Contract NAS5-[redacted], dated May 9, 2000. Contract NAS5-[redacted], Part C [redacted], is a Cost Plus Award Fee (CPAF) contract. [redacted] will be performing subcontract administration, technical management, product engineering logistics support, and product assurance of this contract. The majority of the work will be subcontracted to [redacted]. The total [redacted] CPAF amount for the proposal is $[redacted]. This amount exceeds the value initially budgeted for this work, but is within the overall [redacted] budget.

I found the proposed technical approach to be generally acceptable. However, I did identify 3,097 of unnecessary proposed labor hours. In the contractor's Other Direct Costs (ODCs), I found [redacted] of unnecessary travel costs for the performance of this work, and [redacted] of unnecessary subcontractor ODCs. I am recommending that the costs associated with this labor and these ODCs be removed from the Government's negotiation objective. This proposal includes a statement by the contractor expressing its position that the warranty on the battery cells has expired due to extended dry storage (beyond the 2-year specification).

My recommendations will result in a negotiation position that stands within the government's budget for this work.

Introduction

The flight batteries on the Hubble Space Telescope (HST) are the original batteries launched in April 1990. The life requirement in the specification is a 5-year operational life in orbit after having been activated and stored for a period of not more than 4 years. The battery's useful end of life with respect to cycle life and reserve capacity is estimated to be in the 2003 timeframe. Estimating battery lifetime is dependent upon many variables such as manufacturing uniformity and integrity, cycling regime, charge and discharge characteristics, temperature, and storage conditions. Life tests, stress tests, other battery tests and in orbit capacity measurements have provided other useful estimators of battery lifetime. Battery replacement was originally planned for SM3, but review of the on orbit performance data indicated that delaying replacement to SM4 was an acceptable risk.

Replacement of the batteries is now planned for SM4 in the November 2003 timeframe. When this contract modification was started, a July 2003 date was used for SM4 planning. Since that time, SM3B has slipped to the November 2001 timeframe and SM4 has slipped to the November 2003 timeframe. Replacement battery procurement was originally started in July 1994. In May 1997, battery replacement was deferred from SM3 to SM4. The battery cells were manufactured at that time, but had not been activated with electrolyte. The batteries were placed in cold storage in a dry inert gas environment at that time and have been in storage at EPT since then.

Some of the changes in this proposal are the result of delaying the completion of the battery manufacturing and test from the original delivery dates. As a result of delaying the original procurement, costs were incurred for storage of the cells. Activation and testing of some of the stored cells was also incurred to verify continued integrity in a dry storage environment. Program management costs were also incurred with respect to maintaining a technical dialogue with the government during the period of storage and test. The program delay costs were not anticipated in the original FFP contract between [redacted] and [redacted], and escalation costs associated with program delay will also add cost to the originally proposed costs in the 1994 timeframe.

The Shuttle Transportation System (STS) now requires that power isolation methods be incorporated into Orbital Replacement Units (ORUs) to provide for appropriate safety precautions for the astronauts. Power isolation methods were not previously designed into the battery ORU. GSFC has found it prudent to add a power isolation requirement to this updated procurement to comply with the JSC STS safety requirements. Portions of the Critical Design Review (CDR) will have to be repeated to validate the changes to the design. This new requirement will add cost to the original battery procurement.

Since the HST Program has a design goal of the HST observatory lasting until the 2010 time period, batteries with good reserve capacity are required to accomplish this goal. Therefore, it is in HST's best interest to accept the costs of replacement batteries to accomplish the lifetime requirements of the observatory.

Regarding warranty, the proposal states that "The cell dry storage requirement is 2 years, and acceptable performance was verified after 2 years storage. The cells will have been stored in excess of 4 years at the proposed activation time." ([redacted] proposal to [redacted], page 2) "[redacted]'s warranty for manufacturing and delivered hardware is for a period of 12 months after final acceptance or launch, whichever is first." "Please note that the warranty has expired on the battery cells proposed for use on the HST batteries and modules." ([redacted] proposal to [redacted], page 19). Because of the Integration and Test (I&T) requirements to have flight hardware 12 months prior to launch, the warranty on the battery modules will also expire before launch. From a technical perspective this is not a problem. There is sufficient data supporting dry storage and wet storage lifetime and we are within previously validated limits. Based on that data, I feel that the risk is very low that the batteries will not meet mission requirements. Therefore, the HST Project is willing to accept the risk of maintaining out of warranty batteries in the inventory.

Evaluation

As prime contractor under NAS5-[redacted], [redacted] will be providing the following support:

1. Subcontractor administration support

2. Technical management of the battery procurement

3. Some mechanical, electrical, and thermal engineering support and review of the battery module design

4. Some product engineering logistics support

5. Some product assurance support

The bulk of the design, manufacturing, and test effort will be subcontracted to [redacted], located in [redacted].

The period of performance of this work ends December 1, 2001. Since battery fabrication, assembly, and testing requires 24 months to complete, this contract ends with fabrication of SM4 battery components. This is the very least long lead work for SM4 that is useful to the Program.

The replacement battery design is very similar to the original battery designed in 1988 and integrated on the HST spacecraft in 1990. Evolution of the HST Battery Program is described in the following chart.

	Critical Design Review of the Original Battery	1989
	Performance specs and new design developed under NAS5-50000 core SOW	no date
Mod 56	Limited fabrication and test of new design	10-5-94
	Battery update design review (resulted in design changes to reflect the maturity of the technology)	1-95
Mod 75	Limited battery activation	4-5-95
Mod 86	Manufacture, assembly and test of new batteries	9-12-95
	Letter notification of schedule slip	4-28-97
	Acceptance Data Review (test results after 2 years dry storage)	11-98
Mod 254	Reestablish battery program, require SM4 long lead work and incorporate slip from SM3 to SM4	5-9-00

The primary technical change in the batteries has been going from a "dry sinter" to a "wet slurry" Nickel electrode, in order to produce a better electrochemical utilization of Nickel.

[redacted]'s choice of subcontractor is dictated by the fact that [redacted] has implemented HST's Battery Program from its inception. They are experienced with the original batteries and the new ones. Since new battery development under NAS5-[redacted] Provisioning Item Order (PIO) E-16 was interrupted in 1997 by the Government's reprioritization of the SM3 flight manifest, [redacted] is best qualified to reestablish the program and move it effectively toward completion. Given these facts and [redacted]'s favorable labor rates, I believe the [redacted] is the best choice of subcontractor's for this work.

All of the requirements of Change Order Modification [redacted] have been met by this proposal. Overall, the proposal was a good proposal and most of the information required for evaluation was presented. A fact-finding effort was initiated to clarify some aspects of the proposal regarding work under the core Statement of Work (SOW) versus PIO work. This proposal was in line with battery procurements on Space Station and the Landsat Program with which I have personal experience. In general, the costs are in the range of other similar space battery procurements. Direct comparisons are complicated by differences in time frame, battery capacity, number of batteries, and other battery unique design requirements.

I have read and analyzed this proposal. Messrs. [redacted] and [redacted] of the Space Power Branch (563) have reviewed the proposal and provided me with their insights as well. We have compared this proposal against in house estimates of the work to be done. We have compared this proposal against similar battery programs on Landsat, Earth Observatory Systems (EOS) Terra, the Space Station Freedom Program, and other Satellite Programs with which we have experience. We have applied our engineering judgement developed over many years of satellite design, manufacturing, and test to the evaluation of this proposal.

Technical Approach Evaluation

The proposed technical approach is a sound approach developed over many years and many satellites both at [redacted] and [redacted]. The basic design of the battery draws heavily on the present HST design, and other government satellite programs currently in orbit or under development. Modifications to the existing design are constrained by form, fit, and function requirements on the current HST spacecraft.

Evaluation of Proposed Resources

[redacted] has proposed to place the majority of this effort with the subcontractor who has handled HST battery development in the past, [redacted], [redacted]. I have presented the results of my evaluation for [redacted]'s prime contract proposal first, followed by analysis of the [redacted] subcontract proposal. The results are presented below.

Labor

[redacted] proposes 7,014 hours of engineering and administrative support and 533 hours of related management support for a total of 7,547 hours. [redacted] proposes battery technical support, mechanical engineering support for incorporating the new battery switch, mechanical engineering support for qualifying the new battery switch, product assurance, project engineering and logistics support, subcontractor administration, and management oversight. I think that most of these skill mixes are necessary to accomplish this proposal. It was stating in fact-finding conversations that Responsible Equipment Engineering (REE) manpower was included under the core contract. I do take exception with some of the support and the hours required to accomplish this support.

Table 1 summarizes the [redacted] proposed support and hours and the following paragraphs describe my assessment of the support.

1. Battery Support Engineering: Proposed 884 Accepted 760

   The hours proposed for battery support engineering is close to my estimate. The proposal is for 47 hours per month and I think this can be accomplished in 40 hours per month. I recommend that the hours be reduced by 124.

2. Mechanical Engineering (Design): Proposed 1,200 Accepted 640

   The hours proposed for mechanical engineering support to incorporate the battery switch appears out of line. I can understand a fairly heavy level of support up to the delta CDR, but I do not understand the level of effort proposed after that time. Level of effort for mechanical engineering is usually covered under the core contract. Once the module is designed, there is minimal mechanical engineering required. I recommend that the hours be reduced by 560.

3. Mechanical Engineering (Qualification): Proposed 1,020 Accepted 0

   The hours proposed for mechanical engineering support to qualify the battery switch appear out of line. It is my understanding that the battery switch can be qualified by similarity. I do not understand why the effort is being proposed. A fact-finding was initiated on these items. [redacted] stated in the fact finding that qualification of the battery switch is now required to meet STS vibration requirements. No technical details were provided in the proposal with respect to switch qualification. This issue cannot be resolved until a detailed Technical Interface Meeting (TIM) is held to thoroughly understand the new qualification requirements and proposed engineering and test. It is still not clear why some of these efforts are unique to this procurement and not covered under the core contract. At this point, I recommend that the 1,020 labor hours be deleted as unnecessary.

4. Product Assurance (PA): Proposed 1,005 Accepted 760

   The hours proposed for product assurance are a little high. The contractor is proposing one-third head level of effort. I think that a level of effort of 1 day per week for routine PA and 1 extra day per month for special PA is sufficient for [redacted] oversight. The subcontractor will provide quality assurance day to day and is an ISO 9001 Certified Quality Assurance Site. The Defense Contract Audit Agency (DCAA) Office will provide periodic quality assurance. I think the contractor product assurance should be reduced by 245 hours.

5. Logistics/Project Engineering: Proposed 1,461 Accepted 760

   The hours proposed for logistics/project engineering is a little high. [redacted] is providing parts to [redacted] for the electronic modules. Some degree of coordination and parts kiting is required. I think this work can be accomplished in less time than proposed. I do not understand a level of effort of 40 hours per month once the parts are selected and procured. I think this effort should be reduced by 701 hours.

6. Subcontract Administration: Proposed 1,444 Accepted 1,216

   The hours proposed for subcontract administration is a little high. The contractor is proposing a one-half time effort to administer this subcontract. I think the subcontract can be administered at a 2 day per week level of effort. I think this effort should be reduced by 228 hours.

7. Other Management Oversight: Proposed 533 Accepted 314

The contractor adds 7.6 percent hours for management oversight. Based upon the hours above recommended for reduction, I recommend that the management oversight be reduced accordingly. I estimate this reduction as 219 hours.

Table 1: [redacted] Labor

	Proposed		Accepted		Variance	
	Hours per Month	Total (18 months)	Hours per Month	Total over (18 months)	Hours per Month	Dollars
Engineering	47	884	40	760	124	[redacted]
Mechanical (incorp. Bat. Switch)	43	1,200	160	640	560	[redacted]
Battery Switch Qual.	42	1,020	0	0	1,020	[redacted]
Product Assurance	40	1,005	40	760	245	[redacted]
Logistics/Proj. Engineering	40	1,461	40	760	701	[redacted]
Subcontract Admin	40	1,444	64	1,216	228	[redacted]
Subtotals		7,014		4,136	2,878	[redacted]
Other management hours		533		314	219	[redacted]
Total Hours		7,547		4,450	3,097	[redacted]

ODCs

Materials costs for the prime contract are proposed at $17,059. I accept these cost as reasonable.

Travel costs for the prime contract are proposed at $42,524. I recommend $32,104. Table 2 summarizes the proposed travel for this contract. I think that the proposed travel is acceptable except for the logistics/project engineering trips. The contractor proposes 12 trips for logistics and project engineering. I think that the parts kiting and technical meetings required for this task can be accomplished in 5 trips. I recommend that the travel budget be reduced by $10,420.

Table 2: Travel

	Trips	Cost	Recommendation		Reduction
Subcontract Administration	4	$4,288	4	$4,288	0
Quality Assurance	11	$12,296	11	$12,296	0
Technical Management	8	$7,050	8	$7,050	0
Logistics/Project Engineering	12	$18,890	5	$8,470	$10,420

Miscellaneous ODCs for the prime contract are proposed at $1,137. I support this level of miscellaneous ODCs.

Indirect Costs/Fee

I have not evaluated the reasonableness of [redacted] indirect costs or fee in this report. I leave evaluation of these cost elements to the Resource Analyst and/or the Contracting Officer.

[redacted] Subcontract

[redacted] did not break out the new work from the previously approved modifications. [redacted] stated that [redacted] did not have the current capability to do a cost breakdown by Work Breakdown Structure (WBS). As a result, [redacted] prepared a 2210-6 analysis of the [redacted] proposal. [redacted]' analysis presents [redacted] costs by the change order. My analysis of the proposed costs of each WBS follows:

Table 3 summarizes the [redacted] Analysis. I have reviewed the [redacted] analysis and have the following exceptions to their analysis.

1. WBS 1.0: Accepted as proposed

2. WBS 2.0: [redacted] has proposed [redacted] as new work related to data and documentation. We do need to prepare a delta CDR package, which is a big part of the new work. However, [redacted] has included 3,078 hours for updating the Manufacturing Control Documents (MCD). This has been updated for other similar government programs. I do not agree that there is 3,078 hours of new work associated with documentation. I think this should be reduced by 1,500 hours. I estimate this reduction as $69,522.

3. WBS 3.0: Accepted as proposed

4. WBS 4.0: Accepted as proposed

5. WBS 5.0: Accepted as proposed

6. WBS 6.0: Accepted as proposed

7. WBS 7.0: Accepted as proposed

8. WBS 8.0: Accepted as proposed

9. WBS 9.0: Accepted as proposed

10. WBS 10.0: Accepted as proposed

11. WBS 11.0: Accepted as proposed

12. WBS 12.0: Accepted as proposed

13. WBS 13.0: Accepted as proposed

14. WBS 14.0: Accepted as proposed

15. WBS 15.0: Accepted as proposed

16. WBS 16.0: [redacted] has proposed [redacted] for Test Equipment Manufacture/Upgrade. I think this figure is too high. Much of the activation work for HST will be done on other government program test equipment. The in-house estimates of test equipment are approximately $100,000. I do not agree with [redacted] of upgrade and recommend the figure be reduced to [redacted], which includes new equipment and labor. I recommend a $41,372 reduction.

17. WBS 17.0: Accepted as proposed

Conclusion

After a thorough analysis of the proposal, I found that the technical approach is generally acceptable for negotiation. However, I do recommend that the following points be incorporated into the Government's negotiation objective based on the findings described above:

1. [redacted] of the proposed direct labor be eliminated

2. [redacted] of the subcontractor costs be eliminated

3. [redacted] of the travel budget be eliminated

I leave evaluation of indirect costs and fee to the Resource Analyst and/or Contracting Officer.

Use of these recommendations will result in a negotiation position that stands within the government's budget for this work.

[redacted]

Enclosure

Concurrence:

[redacted] for

[redacted]
Observatory Development Manager
HST Development Project

8/2/00
Date

cc:
440/Mr. D. Scheve
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